Model 1505D-EXP Pressure Chamber Instrument

PMS Instrument Company

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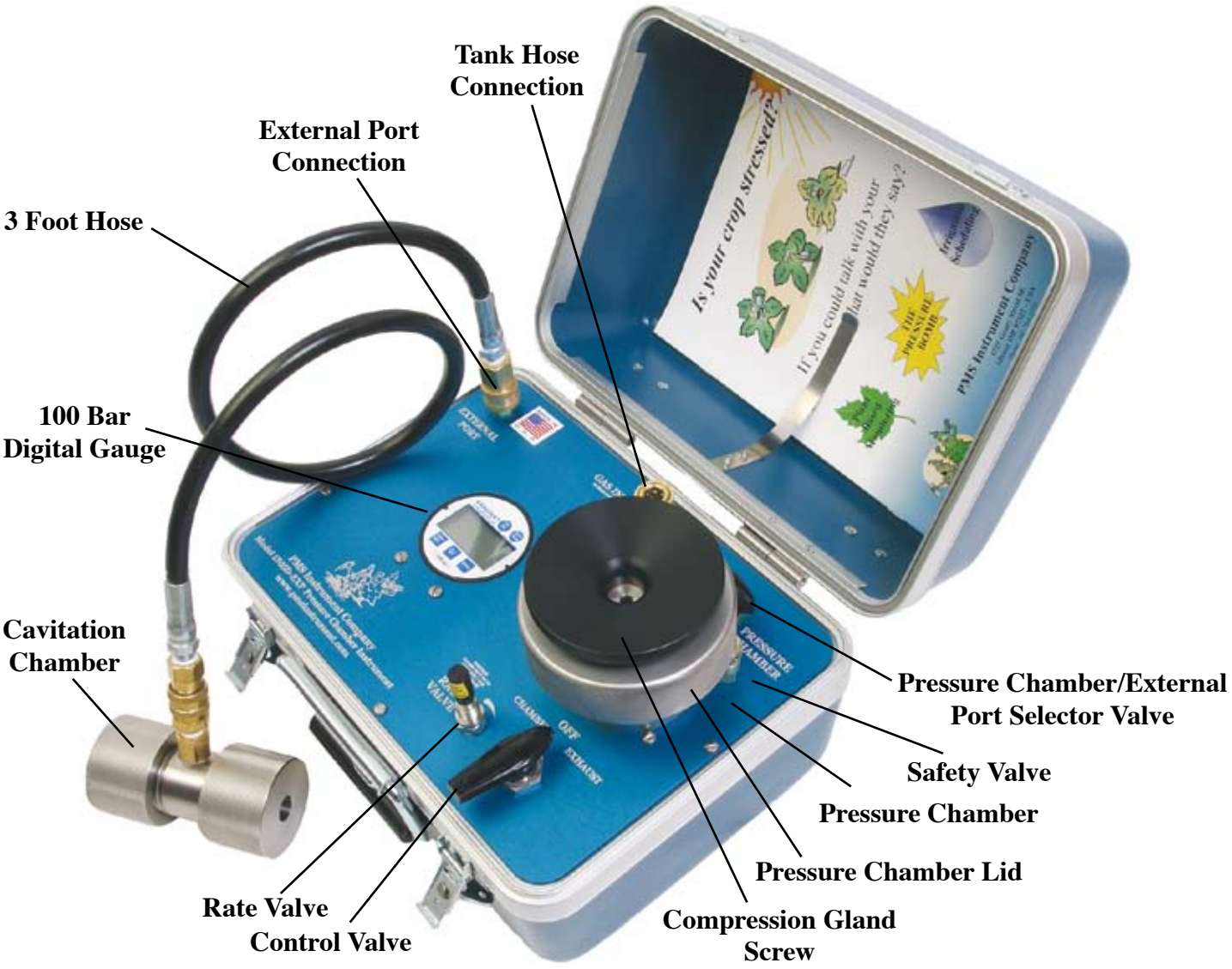
OPERATING INSTRUCTIONS

FOR A COMPLETE LIST OF PICTURE TUTORIALS AND VIDEOS - WWW.PMSINSTRUMENT.COM



Instrument Specifications:

Maximum Instrument Operating Pressure: 100 BAR/ 1500 PSI
Chambers Construction: Solid Stock Stainless Steel
Maximum Supply Tank Pressure: 200 BAR/ 3000 PSI
Weight: 25 Pounds / 11 Kg

1) A lower canopy, shaded leaf is covered with foil-laminate bag.
2) The water in the stem is under tension.
3) The stem is cut and the leaf with bag is sealed inside chamber.
4) Pressure is applied to the leaf until water appears at the cut surface.

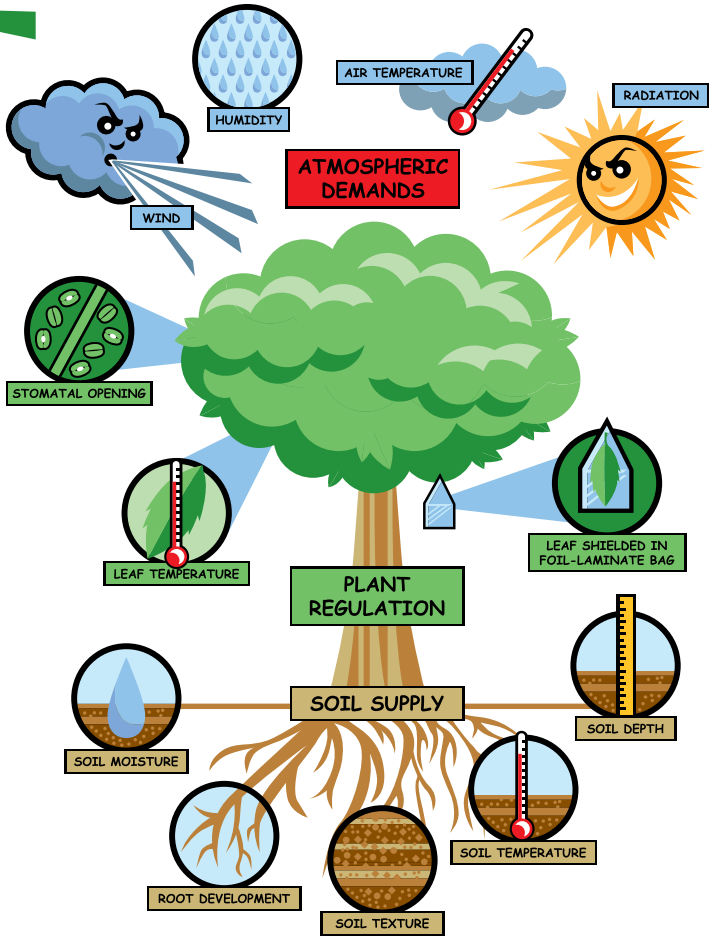
How it Works

Simply put, the pressure chamber is just a device for applying pressure to a leaf or small shoot. Most of the leaf is inside the chamber, but the cut end of the stem (the petiole) is exposed outside the chamber (see illustration at left).
The amount of pressure it takes to cause water to appear at the cut surface of the petiole tells you how much tension the leaf is experiencing on its water supply. A high value of pressure means a high value of tension and a high degree of water stress. These stress levels vary within different species.
The unit of pressure most commonly used is Bar (1 Bar = 14.5 PSI).

Atmospheric Demands: The atmosphere of the plant puts four different demands on the plant: wind, humidity, air temperature, and radiation.

Plant Regulation: The plant regulates water stress by opening and closing the stomata (small holes) on the backside of the leaf. Other regulators used are leaf flagging, rolling and leaf loss. Good root development is also key in regulating water stress.

Soil Supply: Soil composition is critical for the plant. Moisture content is a key factor in PMS. In addition, the temperature of the soil and depth will influence PMS. Depending upon the texture of the soil and how it holds moisture is another important aspect of the soil. Loose sandy soil will drain out moisture quickly while heavy clay will hold moisture longer.



What is Plant Moisture Stress?

The water status of plants, and how to measure it, has received much attention in recent years and for good reason. Plant moisture stress (PMS), or plant water potential, indicates the demand for water within a plant. A PMS measurement indicates the water status of a plant from the "plant's point of view." PMS also tells how the environment affects the plant. High PMS levels cause many physiological processes, such as slowing or stopping photosynthesis. Conditions producing high PMS reduce plant growth and may eventually result in the death of the plant. PMS information can be used to evaluate the plants need for water or how well it is adapted to its environment.

Why Measure Plant Moisture Stress?

Measuring PMS gives an indication of a plants ability to grow and function and can be used as a guide for managing the plants moisture environment so as to improve growth and crop yield. Air temperature, wind speed, humidity, and soil moisture are all integrated by the plant into one single value — PMS. A measure of PMS thus gives an evaluation of the moisture status of a plant from the plants point of view. It is an excellent tool for aiding in irrigation scheduling for crop plants such as almond, walnut, prunes, cotton, and wine grapes or for any application where plant growth is managed such as in nurseries, greenhouses, seedlings or reforestation.

Principle of Operation

The pressure chamber can be thought of as measuring the "blood pressure" of the plant — except that for plants it is water rather than blood. And the water is not pumped by a heart using pressure, but rather pulled with a suction force as water evaporates from the leaves. Water within the plant mainly moves through very small inter-connected cells, collectively called xylem, which are essentially a network of pipes carrying water from the roots to the leaves. The water in the xylem is under tension. As the soil dries or humidity, wind or heat load increases, it becomes increasingly difficult for the roots to keep pace with evaporation from the leaves. This causes the tension to increase. Under these conditions you could say that the plant begins to experience "high blood pressure."

Since tension is measured, negative values are typically reported. An easy way to remember this is to think of water stress as a "deficit." The more the stress the more the plant is experiencing a deficit of water. The scientific name given to this deficit is the "water potential" of the plant. The actual physics of how the water moves from the leaf is more complex than just "squeezing" water out of a leaf, or just bringing water back to where it was when the leaf was cut. However, in practice, the only important factor is for the operator to recognize when water just begins to appear at the cut end of the petiole.

The Plant Moisture Stress (PMS) reading at any given time reflects the plant's interaction with the water supply and the demand for water placed upon the plant by its environment (see diagram on page 2). Since these factors are almost always changing, PMS is nearly always changing. The time of measurement therefore requires careful consideration — PMS is most at midday and least just before sunrise. Pre-sunrise PMS values will usually reflect average soil moisture tension, if the soil is uniformly irrigated. Midday PMS values reflect the tension experienced by the plant as it pulls water from the soil to satisfy the water demand of the atmosphere.

GETTING STARTED

1. Attach the 6 foot hose to a nitrogen cylinder. Connect the other end of the hose to the instrument by retracting the quick-connect and insert the hose end. Ensure this is properly in place by tugging on the hose lightly. Maximum pressure in the cylinder should not exceed **200 Bar** or **3000 PSI**. The hose provided is US Standard (CGA-580). Check your local gas supply store for the proper sized connection if your local standards are not CGA-580.

USING THE PRESSURE CHAMBER

1. Turn **Control Valve** on the instrument to the **"OFF"** position.

2. Select the Pressure Chamber option using the selector valve. This valve will direct the pressure to either the Pressure Chamber or Cavitation Chamber (External Port).

3. **Slowly** open the valve on the nitrogen tank. One-half to one turn is normally sufficient.

CAUTION

Do not uncouple the quick-disconnect fittings when hose is under pressure. Always check to see that the hose and instrument gauges indicate no pressure before operating quick-connect fitting. The purge valve on the 6 foot hose is used to release pressure from the hose.

4. Turn on the digital gauge. **(Press ON/OFF button)**.

5. Check the Safety Valve and Rate Valve using the following procedure. Remove the lid from the chamber by turning the lid counter-clockwise and lifting. Place a solid rubber stopper inside the recessed area under the lid as shown. Put the lid back on the chamber by pushing down and turning clock-wise to the stop. Lid must be turned completely to the stop to close the brass Safety Valve. If stainless steel piston is not depressed, chamber will not pressurize. This is a safety feature of the instrument to ensure lid is properly seated.

Turn control valve to **CHAMBER** position and pressurize the chamber. Adjust **Rate Valve** until pressure in the chamber increases at the desired rate. ½ Bar per second is a recommended rate of increase. Rate may be changed at any time, even while pressurizing a sample.

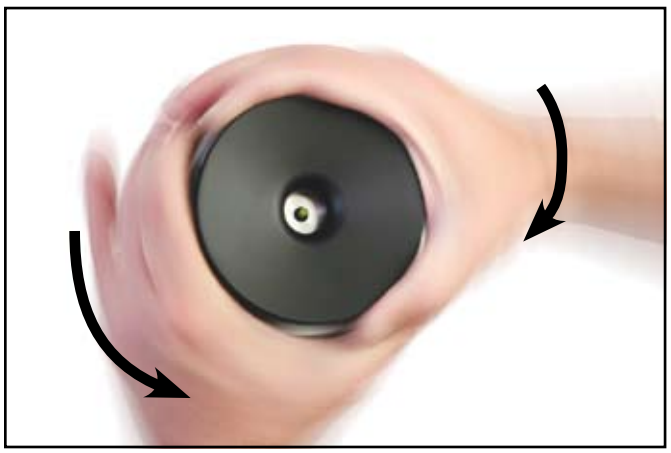
CAUTION

Do not close **Rate Valve** completely or use as a Shut-Off valve.

Valve may be damaged as a result.

6. Turn the control valve to **EXHAUST** position to release pressure from the chamber. Remove the lid and solid rubber stopper from the inside of lid. You are now ready to take readings.

7. You can now select a leaf to test. To seal the sample, insert the cut end of the petiole (stem) through the hole from the bottom side of the chamber lid. Twist the **Compression Screw** clockwise to seal the sample in the lid. For more detailed information about sampling – consult our website.



USING THE CAVITATION CHAMBER

1. Attach the 3 foot hose to the External Port and to the Cavitation Chamber.

2. Turn **Control Valve** on the instrument to the **"OFF"** position.

3. Select the Cavitation Chamber (External Port) option using the selector valve. This valve will direct direct the pressure to either the Pressure Chamber or Cavitation Chamber (External Port).

4. **Slowly** open the valve on the nitrogen tank. One-half to one turn is normally sufficient.

5. Turn on the digital gauge. **(Press ON/OFF button)**.

CAUTION

Do not uncouple the quick-disconnect fittings when hose is under pressure. Always check to see that gauge on tank and instrument read zero pressure before operating quick-disconnect fitting. The pressure relief valve on the 6 foot hose is used to bleed pressure from the hoses.

SELECTING A SAMPLE FOR THE CAVITATION CHAMBER

1. Cut a sample from a plant to be tested. Use a sharp blade and avoid breaking the sample. When searching for a sample be sure it is long enough to properly extend through the Cavitation Chamber so as to be easy to work with.

2. As there are many ways of connecting samples to a head of water and measuring water conductivity, it has been left up to the user to supply tubing, connections, head of water and measuring devices for testing conductivity in the sample. Laboratory & Medical supply stores will have a vast amount of tubing, connections, flow-gates, syringes and other supplies that will be useful in this area.

3. When connecting samples be careful with air bubbles inside tubing or connectors as this can affect results. Cutting samples and attaching connections underwater will help keep samples from cavitating before testing.

4. Once the sample is ready, remove both lids of the Cavitation Chamber and insert the sample into a proper sized gasket. Next, fix the sample into place in the gasket seat of the chamber. Slide the appropriate sized insert over the sample and behind the gasket. Finish by threading on the lid. Repeat this process on the other side.

5. The Cavitation Chamber is now ready for testing the sample. Some testing of conductivity before cavitation may be necessary depending upon desired results. Next, turn the control valve to CHAMBER position and pressurize the Cavitation Chamber to the desired pressure. After pressure level is attained and maintained for desired timing, turn control valve to EXHAUST position. Again, conductivity testing will take place at this time. Repeat procedure at higher incremental levels with conductivity testing in between until finished.

DIGITAL GAUGE OPERATION

KEYPAD OPERATION

There are five buttons on the keypad, which function as follows:

1) ON/OFF

This button manually turns the unit on or off without regard to mode of operation.

When the unit is turned on, the gauge will display, in 1 second intervals, the following start up sequence:

1) Firmware version
    a. Top line: numerical firmware rev number
    b. Bottom line: VER
2) Pressure range
    a. Top line: Full Scale pressure range
    b. Bottom line: units of measure to which the unit was calibrated (PSI).
3) Current pressure
    a. Top line: pressure currently being sensed by the gauge.
    b. Bottom line: selected unit of measure.

If the ON/OFF button is pressed and held for three seconds, a menu will appear, which can be scrolled through by pressing the ON/OFF button. The menu will offer the following selections, which will be blinking to indicate a selectable option:

4) NEVER (default) – the gauge will stay on until the ON/OFF button is pushed again.
5) 5 MIN – the gauge will turn off 5 minutes after it is turned on.
6) 10 MIN – the gauge will turn off 10 minutes after it is turned on.
7) 20 MIN – the gauge will turn off 20 minutes after it is turned on.

A selection is made by pressing the ON/OFF button for 3 seconds while an option is blinking. Once a selection is made, or scrolled past “20 MIN”, the gauge will return to current pressure.

2) ZERO/CLEAR

With the gauge reading the current pressure, this button will zero the display provided the reading is below the lesser of 50 psi or ±5% of the pressure range (e.g. between –50 and 50 psi on a 1000 psi gauge).

3) MIN/MAX

Pressing this button will display the maximum pressure the gauge has sensed since being turned on, in the top line of the display. The bottom line will read “MAX”. Pressing the button again will display the minimum pressure the gauge has sensed since being turned on, and show “MIN”. Pressing a third time will revert the gauge back to the current pressure. The “MAX” or “MIN” values will be cleared by depressing the ZERO/CLEAR button with value displayed. Both values will be cleared when the gauge is turned off (manually or automatically).

4) LIGHT

This button toggles the display backlight on and off. However, if this button is held for 3 seconds a menu will appear which can be scrolled through by pressing the “LIGHT” button. The menu will offer the following selections, which will be blinking to indicate a selectable option:

1) IMMED – the backlight will only be on while the “LIGHT” button is being pressed.
2) 30 SEC – the backlight will turn off 30 seconds after the “LIGHT” button is no longer being pressed.
3) 1 MIN – the backlight will turn off 1 minute after the “LIGHT” button is no longer being pressed.
4) 5 MIN – the backlight will turn off 5 minutes after the “LIGHT” button is no longer being pressed.
5) NEVER – (default) – the backlight will stay on until the “LIGHT” button is pressed again.

Note: If while in the menu, the “LIGHT” button is not pressed for 3 seconds (to either scroll or select), the gauge will revert back to the current pressure. While in this menu, pressing the “ZERO/CLEAR” button will also bring the gauge back to the current pressure. The backlight option selected will be saved when the gauge is turned off.

5) UNITS

This button accesses a scrollable menu of pressure measurement “unit” options: psi, Bar, kg/cm², kPa, mPa, ftH20, in. Hg, mmHg, cmHg. For most water potential readings Bar or mPa scale is used.

Pressing the “UNITS” button once will show the first selection (blinking). Pressing the button again will show the next blinking entry, and so on until the menu is completed. Upon completion of the menu, pressing the button again will exit the menu and use the last selected units. Selection of a units option is made by pressing the “UNITS” button for 3 seconds while the option is being displayed. If while in the menu, the “UNITS” button is not depressed in 3 seconds (to either scroll or select) the unit will revert back to the current pressure. While in this menu, pressing the “ZERO/CLEAR” button will also bring the unit back to the current pressure. The units option selected will be saved when the gauge is turned off.

BATTERY

Gauge powered by two **AAA** batteries.

The battery icon located in the lower right hand corner of the display – indicates the power level with three segments:

1) No segments filled: Less than 10% battery life remaining.
2) One segment filled: 10% to 25% battery life remaining.
3) Two segments filled: 25% to 50% battery life remaining.
4) Three segments filled: 50% to 100% battery life remaining.

When the batteries get too weak for the gauge to operate reliably, the gauge will shut off. If the gauge is turned on with batteries in this condition, the version and range display will show momentarily, but the gauge will again shut off. If the batteries are too weak the gauge will not turn on.

REPLACING THE BATTERIES

1) Remove the 4 screws that hold the instrument panel inside the case.
2) Remove the instrument from inside the case and turn it over.
3) Locate the back of the gauge. Using your thumb slide the back panel from the gauge.
4) Replace batteries with high quality fresh **AAA** batteries. Recycle old batteries according to local recycling laws.

CALIBRATION / ERROR

For any calibration or error in gauge performance please contact PMS Instrument Company.

WHEN YOU HAVE COMPLETED MEASUREMENTS

1. Close valve on nitrogen tank.

2. Release pressure from 6 foot hose by using the purge valve on the hose. Release any excess pressure in chamber by turning control valve to EXHAUST position.

3. Check gauge on hose to ensure it indicates no pressure. Check gauge on instrument to ensure it indicates no pressure. Disconnect the hand nut from the nitrogen tank and then the quick-disconnect fitting on the instrument.

INSTRUMENT MAINTENANCE

1) Remove the O-Ring from around the lid. Clean with rag and lubricate with Petroleum Jelly for optimal performance.

2) Remove the Compression Gland Screw from the lid. Clean the threads of the Screw and the Compression Gland Base with a rag. Lubricate this with Lithium Grease (White Grease) for optimal performance.

3) Compression Gland Gasket can be cleaned with a rubber treatment such as used with automobile detailing (Armour All brand) for optimal performance. When Compression Gland Gasket becomes worn – replace with new gasket for optimal performance.

For a complete list of picture tutorials and videos - www.pmsinstrument.com

CONTROL VALVE ADJUSTMENT

The control valve will need periodic adjustment depending upon usage. Adjustment is required if leakage occurs in the pressurized instrument with the control valve in the OFF position. Two tools are needed and have been provided with your instrument. A 3/32 inch Allen Key is used to remove the Control Valve Handle. A 11/32 inch wrench is used to adjust the packing on the valve.

1. Pressurize the instrument with the control valve in the OFF position.

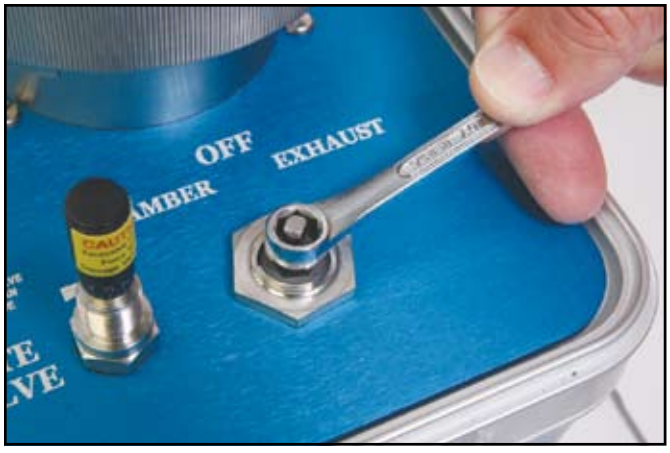
2. Loosen the hex screw with the Allen Key. It is located on the side of the Control Valve Handle.

3. Using the 11/32 wrench, slowly tighten the packing gland nut until the leak stops.

CAUTION

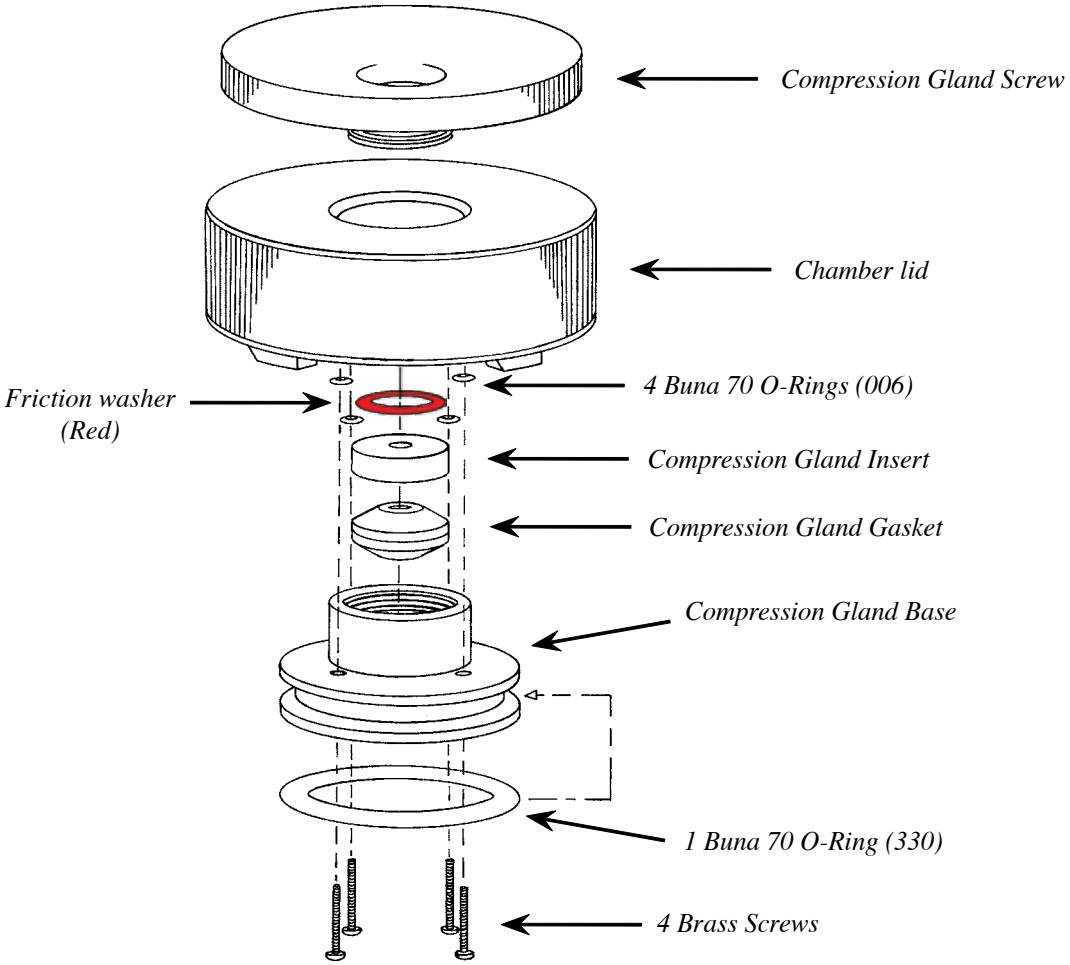
Do not overtighten the packing gland!
Permanent damage to the valve will result.

4. Replace the handle and tighten the hex screw.



Maintenance for Compression Gland Lid

Maintaining the Compression Gland Lid is quite simple. Keep the O-ring around the Compression Gland Insert clean and lubricated with petroleum jelly. Occasionally unscrew the compression screw and take out the Compression Gland Insert and Compression Gland Gasket inside for cleaning. We recommend lubricating the compression screw threads with a Lithium based lubricant such as white grease or other lubricant to maintain the threads and ensure easy operation. Keeping these threads clean is important for ensuring operability of the cover. Clean the Compression Gland Gasket with ARMOR ALL or other similar cleaner. Over time the compression gland gasket will become worn, a replacement has been supplied for your convenience. If additional gaskets are needed, you may purchase them directly from PMS Instrument Company.



TO RE-ASSEMBLE THE COMPRESSION GLAND START BY:

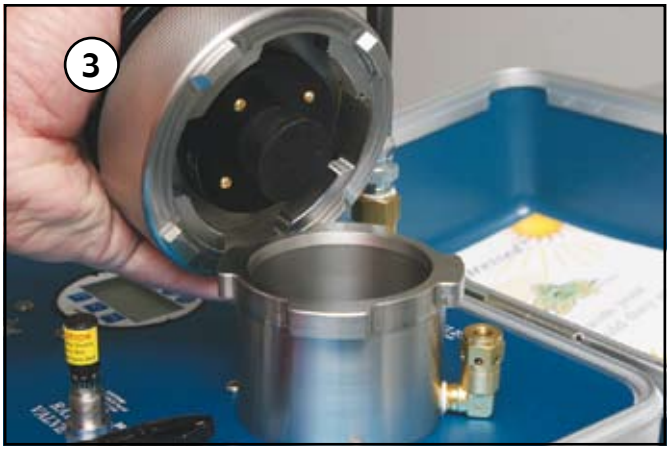
1. Sliding the Compression Gland into the Chamber Lid
2. Insert the 4 brass screws and screw the insert down tight — make sure that the 4 small O-rings are in place first
3. Put the Compression Gland Gasket into the Compression Gland Base
4. Put the Compression Gland Insert on top of the gasket and the Friction Washer on top of the Compression Gland Insert
5. Be sure to lubricate the threads and screw the Compression Screw into the Compression Gland Base
6. The Compression Gland Cover is now ready for use

Testing the Safety Valve

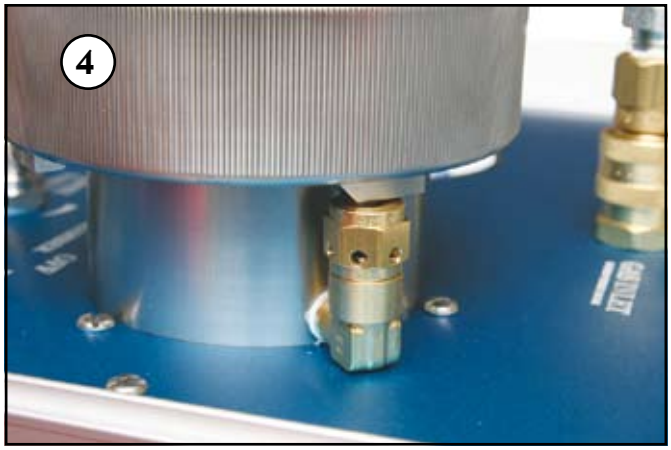
The instrument is fitted with a Safety Valve to ensure that the lid is properly seated prior to pressurizing the chamber. The Safety Valve will vent the chamber if the lid is not properly closed. **This valve MUST be tested at the beginning of each measurement session.**

First, use your finger to depress the piston so that it is inside the safety valve

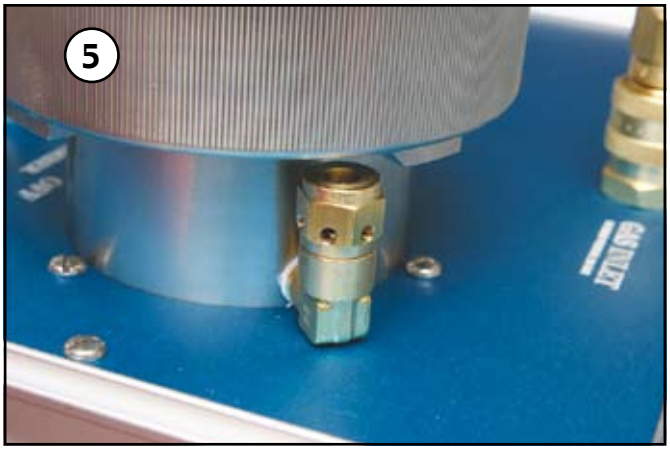
Insert a solid rubber gasket into the lid



Install the lid on the chamber

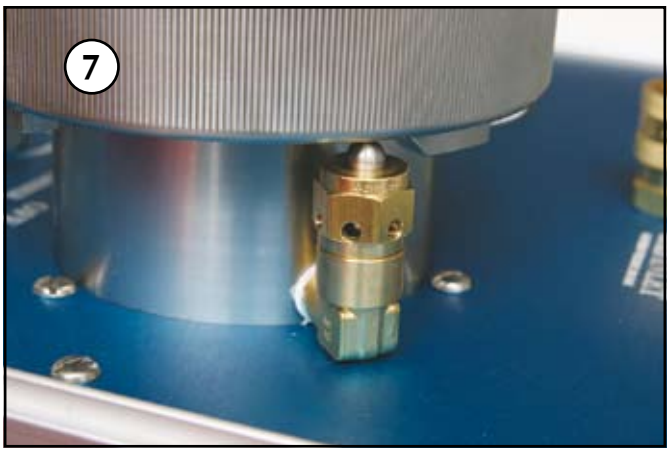


Turn the lid clockwise to the stop. Ensure the cam is directly over the piston



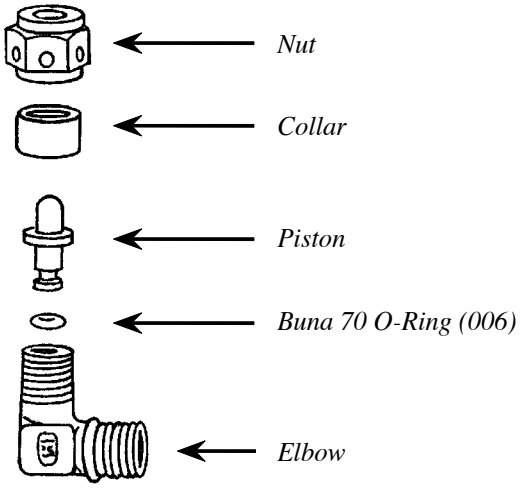
Then turn the lid back so that the cam is not blocking the piston

Begin to slowly apply pressure to the chamber



The safety valve should pop open before the pressure reaches 2 bar

SAFETY VALVE



You will hear nitrogen escaping from the valve and the pressure will not increase in the chamber. If it does not, turn the control to EXHAUST, then remove the nut and piston of the safety valve and lubricate the O-ring on the piston with petroleum jelly. Reassemble and test the safety valve again. When the safety valve opens, the pressure in the chamber should drop to near zero. This time the safety valve should open at a pressure below 2 bar. If it does not, remove the nut and piston of the safety valve and again clean and lubricate the O-ring on the piston with petroleum jelly. Check for any foreign debris then reassemble and test the safety valve again.

The safety valve is an important safety component of the instrument. Do not attempt to operate the instrument until the safety valve is operating properly; that is, until it is releasing the chamber pressure at less than 2 bar pressure,

As an added safety precaution, the cover should be left in only one of two positions:

1. On the chamber and completely locked in place; or
2. Completely removed from the chamber.

The lid should never be left in any intermediate position.

PMS Instrument Company

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EU
Declaration of Conformity

We,

PMS Instrument Company
1725 Geary Street SE
Albany, OR 97322 USA

Declare under our sole responsibility that the following products:

Pump-Up Chamber, 600 Pressure Chamber, 605 Pressure Chamber, 615 Pressure Chamber, 615D Pressure Chamber, 1000 Pressure Chamber, 1005 Pressure Chamber, 1000 "upgraded to 100 Bar" Pressure Chamber, 1005 "upgraded to 100 Bar" Pressure Chamber.

In addition, the following accessories are included:

Cavitation Chamber

To which this declaration relates is in conformity with the following Standards or other normative documents:

EN ISO 12100-1:2003, EN ISO 12100-2:2003, 97/37/EC Annex I

Following the provisions of Directives;

98/37/EC, 97/37/EC (Equipment is below class I limits per the PED)

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Responsible party in the European Union: _____

Officer: Jean-Luc AVERLAN
Sols Mesures

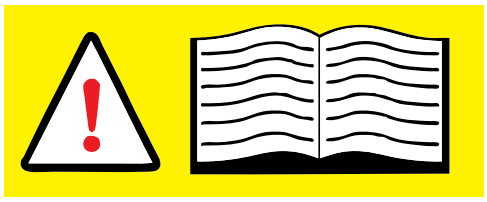
Place: Elancourt, France
Date: May 6, 2009

President, PMS Instrument Company: _____

Officer: Jeff Hamel, President
PMS Instrument Company

Place: Albany, Oregon, USA
Date: May 6, 2009

Warnings, Considerations and Limits



Intended Usage

The Pressure Chamber Instrument usage is intended for applying pressure to plant material to determine water potential or to extract water xylem from plants. It should not be used to pressurize anything other than plant material. Using this instrument for any other purpose or in an unsafe manner could result in harm to the user.

Upon receiving the instrument or using it for the first time, each user should familiarize themselves thoroughly with all safety features and set-up process to avoid damage of instrument or physical injury to operator.

Working Environment

The instrument is robust and durable and designed for outdoor use. It may be used in temperatures as high as 55º C and as low as –10º C. It is best to store inside where temperatures do not exceed 40º C or lower than 0º C. Keep in clean and dry area. Store on a flat surface that is protected from being struck or damaged. Normal vibration during use will not affect performance of the instrument such as travel in vehicle or all terrain vehicles. Excessive shaking and vibration can cause damage. If the instrument has received a hard blow or hit, it should be evaluated prior to further use. The instrument is not vulnerable to humidity but should never be submersed in water. If the instrument becomes submersed, allow it to dry and evaluate the instrument prior to further use.

Transporting Instrument

Transporting the instrument by any mode should be done with care as not to strike the instrument against anything hard as this might damage the instrument. If transporting by vehicle such as truck, car or all terrain vehicle; the instrument should be securely fastened in order to avoid any damage to the instrument.

Maintenance

Most maintenance issues can be done without much training. Consult the maintenance pages in this manual. However, any adjustments to piping or high pressure connectors should only be performed by factory or authorized personnel. Consult us directly for more information.

Disposal or Decommission of the Instrument

While the instrument should provide years of use, it is possible that sometime it will be disposed of. Local recycling guidelines should be followed for disposal.